

1. Work requester fills out this section.

☐ Standing Work Permit

Requester: Don Lynch	Date: 2/6/2007	Ext.: 2253	Dept/Div/Group: PO/PHENIX
Other Contact person (if different from requester): Sal Marino			Ext.: 3704
Work Control Coordinator: Don Lynch		Start Date: 2/7/2007	Est. End Date: 2/14/2007
Brief Description of Work: Install MuID Collar			
Building: 1008	Room: IR	Equipment: MuID Collar, IR Crane	Service Provider: PHENIX Techs

WCC, Requester/Designee, Service Provider, and ES&H (as necessary) fill out this section or attach analysis

<b>ES&amp;H ANALYSIS</b>				
<b>Radiation Concerns</b>	<input checked="" type="checkbox"/> None	<input type="checkbox"/> Activation	<input type="checkbox"/> Airborne	<input type="checkbox"/> Contamination
Radiation Generating Devices:	<input type="checkbox"/> Radiography	<input type="checkbox"/> Moisture Density Gauges	<input type="checkbox"/> Soil Density Gauges	<input type="checkbox"/> X-ray Equipment
<input type="checkbox"/> Special nuclear materials involved, notify Isotope Special Materials Group			<input type="checkbox"/> Fissionable materials involved, notify Laboratory Criticality Officer	
<b>Safety Concerns</b>	<input checked="" type="checkbox"/> None	<input type="checkbox"/> Ergonomics	<input type="checkbox"/> Transport of Haz/Rad Material	
<input type="checkbox"/> Adding/Removing Walls or Roofs	<input type="checkbox"/> Confined Space*	<input type="checkbox"/> Explosives	<input type="checkbox"/> Lead*	<input type="checkbox"/> Penetrating Fire Walls
	<input type="checkbox"/> Corrosive	<input type="checkbox"/> Flammable	<input type="checkbox"/> Magnetic Field*	<input type="checkbox"/> Pressurized Systems
<input type="checkbox"/> Asbestos*	<input type="checkbox"/> Cryogenic	<input type="checkbox"/> Fumes/Mist/Dust*	<input type="checkbox"/> Material Handling	<input checked="" type="checkbox"/> Rigging/XXXXI Lift
<input type="checkbox"/> Beryllium*	<input type="checkbox"/> Electrical	<input type="checkbox"/> Heat/Cold Stress	<input type="checkbox"/> Noise*	<input type="checkbox"/> Toxic Materials*
<input type="checkbox"/> Biohazard*	<input checked="" type="checkbox"/> Elevated Work*	<input type="checkbox"/> Hydraulic	<input type="checkbox"/> Non-ionizing Radiation*	<input type="checkbox"/> Vacuum
<input type="checkbox"/> Chemicals*	<input type="checkbox"/> Excavation	<input type="checkbox"/> Lasers*	<input type="checkbox"/> Oxygen Deficiency*	<input type="checkbox"/> Other
* Does this work require medical clearance or surveillance from the Occupational Medicine Clinic? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No				
<b>Environmental Concerns</b>	<input checked="" type="checkbox"/> None	<input type="checkbox"/> Work impacts Environmental Permit No.		
<input type="checkbox"/> Atmospheric Discharges (rad/non-rad)	<input type="checkbox"/> Land Use	<input type="checkbox"/> Soil Activation/contamination	<input type="checkbox"/> Waste-Mixed	
<input type="checkbox"/> Chemical or Rad Material Storage or Use	<input type="checkbox"/> Liquid Discharges	<input type="checkbox"/> Waste-Clean	<input type="checkbox"/> Waste-Radioactive	
<input type="checkbox"/> Cesspools (UIC)	<input type="checkbox"/> Oil/PCB Management	<input type="checkbox"/> Waste-Hazardous	<input type="checkbox"/> Waste-Regulated Medical	
<input type="checkbox"/> High water/power consumption	<input type="checkbox"/> Spill potential	<input type="checkbox"/> Waste-Industrial	<input type="checkbox"/> Underground Duct/Piping	
Waste disposition by: <input type="checkbox"/> Other				
<b>Pollution Prevention (P2)/Waste Minimization Opportunity:</b>	<input checked="" type="checkbox"/> None <input type="checkbox"/> Yes			
<b>FACILITY CONCERNS</b>	<input checked="" type="checkbox"/> None			
<input type="checkbox"/> Access/Egress Limitations	<input type="checkbox"/> Electrical Noise	<input type="checkbox"/> Potential to Cause a False Alarm	<input type="checkbox"/> Vibrations	
	<input type="checkbox"/> Impacts Facility Use Agreement	<input type="checkbox"/> Temperature Change	<input type="checkbox"/> Other	
<input type="checkbox"/> Configuration Control	<input type="checkbox"/> Maintenance Work on Ventilation Systems	<input type="checkbox"/> Utility Interruptions		
<b>WORK CONTROLS</b>				
<b>Work Practices</b>				
<input type="checkbox"/> None	<input type="checkbox"/> Exhaust Ventilation	<input type="checkbox"/> Lockout/Tagout	<input type="checkbox"/> Spill Containment	<input type="checkbox"/> Security (see Instruction Sheet)
<input checked="" type="checkbox"/> Back-up Person/Watch	<input type="checkbox"/> HP Coverage	<input type="checkbox"/> Posting/Warning Signs	<input type="checkbox"/> Time Limitation	<input type="checkbox"/> Other
<input type="checkbox"/> Barricades	<input type="checkbox"/> IH Survey	<input type="checkbox"/> Scaffolding-requires inspection	<input type="checkbox"/> Warning Alarm (i.e. "high level")	
<b>Protective Equipment</b>				
<input type="checkbox"/> None	<input type="checkbox"/> Ear Plugs	<input checked="" type="checkbox"/> Gloves	<input type="checkbox"/> Lab Coat	<input type="checkbox"/> Safety Glasses
<input type="checkbox"/> Coveralls	<input type="checkbox"/> Ear Muffs	<input type="checkbox"/> Goggles	<input type="checkbox"/> Respirator	<input type="checkbox"/> Safety Harness
<input type="checkbox"/> Disposable Clothing	<input type="checkbox"/> Face Shield	<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Shoe Covers	<input checked="" type="checkbox"/> Safety Shoes <input type="checkbox"/> Other
<b>Permits Required (Permits must be valid when job is scheduled.)</b>				
<input checked="" type="checkbox"/> None	<input type="checkbox"/> Cutting/Welding	<input type="checkbox"/> Impair Fire Protection Systems		
<input type="checkbox"/> Concrete/Masonry Penetration	<input type="checkbox"/> Digging/Core Drilling	<input type="checkbox"/> Rad Work Permit-RWP No		
<input type="checkbox"/> Confined Space Entry	<input type="checkbox"/> Electrical Working Hot	<input type="checkbox"/> Other		
<b>Dosimetry/Monitoring</b>				
<input checked="" type="checkbox"/> None	<input type="checkbox"/> Heat Stress Monitor	<input type="checkbox"/> Real Time Monitor	<input type="checkbox"/> TLD	
<input type="checkbox"/> Air Effluent	<input type="checkbox"/> Noise Survey/Dosimeter	<input type="checkbox"/> Self-reading Pencil Dosimeter	<input type="checkbox"/> Waste Characterization	
<input type="checkbox"/> Ground Water	<input type="checkbox"/> O <sub>2</sub> /Combustible Gas	<input type="checkbox"/> Self-reading Digital Dosimeter	<input type="checkbox"/> Other	
<input type="checkbox"/> Liquid Effluent	<input type="checkbox"/> Passive Vapor Monitor	<input type="checkbox"/> Sorbent Tube/Filter Pump		
<b>Training Requirements (List below specific training requirements)</b>				
PHENIX Awareness, C-A access, Crane Operator, Working at Heights				
<b>Based on analysis above, the Walkdown Team determines the risk, complexity, and coordination ratings below:</b>			<b>If using the permit when all hazard ratings are low, only the following need to sign: ( Although allowed, there is no need to use back of form)</b>	
<b>ES&amp;H Risk Level:</b>	<input type="checkbox"/> Low	<input checked="" type="checkbox"/> Moderate	<input type="checkbox"/> High	WCC: Don Lynch Date: 2/6/2007
<b>Complexity Level:</b>	<input checked="" type="checkbox"/> Low	<input type="checkbox"/> Moderate	<input type="checkbox"/> High	Service Provider: _____ Date: _____
<b>Work Coordination:</b>	<input checked="" type="checkbox"/> Low	<input type="checkbox"/> Moderate	<input type="checkbox"/> High	Authorization to start _____ Date: _____
(Departmental Sup/WCC/Designee)				

3. Both work requester and service provider contribute to work plan (use attachments for detailed plans)

<b>Work Plan</b> (procedures, timing, equipment, and personnel availability need to be addressed): See Attached MulD Collar Installation procedure and related documentation.				
Special Working Conditions Required: None				
Operational Limits Imposed: None				
Post Work Testing Required: No				
Job Safety Analysis Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			Walkdown Required: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
<b>Reviewed by:</b> Primary Reviewer will determine the size of the review team and the other signatures required based on hazards and job complexity. Primary Reviewer signature means that the hazards and risks that could impact ES&H have been identified and will be controlled according to BNL requirements.				
<b>Title</b>	<b>Name (print)</b>	<b>Signature</b>	<b>Life #</b>	<b>Date</b>
Primary Reviewer				
ES&H Professional				
Other				
Other				
Work Control Coordinator				
Service Provider				
Review Done: <input type="checkbox"/> in series		<input type="checkbox"/> team		

**4. Job site personnel fill out this section.**

Note: Signature indicates personnel performing work have read and understand the hazards and permit requirements (including any attachments).			
Job Supervisor:		Contractor Supervisor:	
Workers:	Life#:	Workers :	Life#:
Workers are encouraged to provide feedback on ES&H concerns or on ideas for improved job work flow. Use feedback form or space below.			

**5. Departmental Job Supervisor, Work Control Coordinator/Designee**

Conditions are appropriate to start work: (Permit has been reviewed, work controls are in place and site is ready for job.)			
Name:	Signature:	Life#:	Date:

**6. Departmental Job Supervisor, Work Requester/Designee determines if Post Job Review is required.** ☐ Yes ☐ No

Post Job Review (Fill in names of reviewers)			
Name:	Signature:	Life#:	Date:
Name:	Signature:	Life#:	Date:

**7. Worker provides feedback.**

Worker Feedback (use attached sheets as necessary) a) WCM/WCC: Is any feedback required? <input type="checkbox"/> Yes <input type="checkbox"/> No  b) Workers: Are there better methods or safer ways to perform this job in the future? <input type="checkbox"/> Yes <input type="checkbox"/> No
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**8. Closeout: Work Control Coordinator (authorizing dept.) checks quality of completed permit and ensures the work site is left in an acceptable condition. (WCC can delegate clean up of work area to work supervisor)**

Name:	Signature:	Life#:	Date:
Comments:			



## Installing and Removing The MuID Collar

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procedure name

**PHENIX Procedure No. PP-2.5.5.4-25**

**Revision: A**

**Date: 02/05/2007**

### **Hand Processed Changes**

<b><u>HPC No.</u></b>	<b><u>Date</u></b>	<b><u>Page Nos.</u></b>	<b><u>Initials</u></b>
_____	_____	_____	_____
_____	_____	_____	_____
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_____	_____	_____	_____
_____	_____	_____	_____

### **Approvals**

\_\_\_\_\_  
PHENIX S E & I      Date

\_\_\_\_\_  
Cognizant Scientist/Engineer      Date  
/Activity Manager

\_\_\_\_\_  
PHENIX QA/Safety      Date

**REVISION CONTROL SHEET**

<b>LETTER</b>	<b>DESCRIPTION</b>	<b>DATE</b>	<b>WRITTEN BY</b>	<b>APPROVED BY</b>	<b>TYPED BY</b>
A	First Issue		D. Lynch	(see Title Page)	D. Lynch

## 1.0 **Purpose & Scope**

- 1.1 The purpose of this procedure is to provide directions for the installation and removal of the MuID collar as required before and after major maintenance shutdowns of the PHENIX experiment.
- 1.2 Installation and removal of the MuID collar is a delicate operation involving the installation of a massive 7 ton collar around a thin stainless steel beampipe immediately south of the PHENIX interaction point.
- 1.3 A critical lift evaluation of this operation demonstrates that the consequences of a lifting accident do not rise to the level of a BNL defined Critical lift. The potential for serious consequences due to a lifting accident are severe enough, however, to warrant a pre-engineered lift procedure to assure that the chances of a lifting accident are minimized to *as low as reasonably achievable*.
- 1.4 This procedure covers the procedure for performing MuID collar lifts, installation and removal. This procedure should be invoked by a specific work plan for each performance of the tasks described herein. Such a work plan shall designate specific persons to assume the roles of “person-in-charge” “crane operator” and “lift support personnel” as defined generically herein.

## 2.0 **Responsibilities**

- 2.1 All operations shall be performed under the direction of the “Person-in-Charge” or his designee.
- 2.2 All persons involved in this operation shall maintain a distraction free environment and shall remain fully focused on this task alone throughout the operation.
- 2.3 The person-in-charge shall ensure that all persons not involved in this operation shall stay clear from the area of this operation for the duration of the operation.

## 3.0 **Prerequisites**

- 3.1 Training: All persons involved in the operations described in this procedure shall have current training in PHENIX Awareness, C-A Access, Crane operator, and working at heights
- 3.2 All persons involved in the operations described in this procedure shall have read and reviewed this procedure prior to commencing this operation.

- 3.3 In addition to the person-in-charge, at least two technicians are to be assigned to conduct this procedure, with their sole focus being on the installation/removal of the MuID Collars as appropriate.
- 3.4 The lifting equipment (crane, shackles, attaching hardware, slings, chainfall, etc. shall have current valid inspection stickers and shall be 100% visually inspected for defects immediately prior to commencing this operation.
- 3.5 A pre-lift meeting shall be held by the person-in-charge of the lift, and all other persons involved in the operation. At the meeting this procedure will be reviewed and acknowledged by each person involved so that each operator is fully aware of his responsibilities and each other persons responsibilities in this task.
- 3.6 Prior to commencing the tasks defined in this procedure, the C-A vacuum group is to be notified and a request made to close the vacuum isolation valves at the north and south of the PHENIX .

#### **4.0 Precautions**

- 4.1 **There is a potential for personnel and/or equipment injury/damage during this operation in the event of a lift failure. Personnel and portable equipment not specifically involved in this procedure shall be kept clear of the task area for the duration of the task.**
- 4.2 **There is a potential of damaging the beam stainless steel beampipe which the subject collar is intended to surround during installation in the event of a crane operator error or equipment malfunction. Accordingly maximum care shall be taken to prevent sudden or jerky moves on the crane which could cause the load to swing. In addition the collar is to be oriented into its installation position sufficiently away from the beampipe to assure that the load, slings and lifting apparatus can not contact the beampipe during the load orientation process.**
- 4.3 **There is a potential for pinching and crushing fingers or other personal appendages between the south muon magnet (MMS) and the MuID collar during installation. Maximum care shall be taken by the operators to prevent positioning any body parts between the collar and the MMS during the installation operation. *Note: There is likely to be residual magnetism in the collar and/or the MMS collar attachment point which would cause the collar to “snap” onto the magnet when in close proximity.***

## **Procedure**

Figure 1 is a plan view of the area in the PHENIX IR where the MuID collars are pre-positioned prior to the installation described herein and the installed location. Figure 2 is an elevation view looking north along the beamline. Figure 3 shows the location of the center of gravity of the collar halves. Figure 4 shows is a schematic indicating the attachments of the lifting apparatus. All operators participating in this operation should be familiar with all of these figures.

This operation requires 3 qualified technicians. In addition a cognizant engineer or scientist may be in attendance during the lift. No other personnel or equipment should be present in the immediate area of this operation. All technicians shall wear appropriate safety protective equipment (safety shoes, hard hat, gloves). Any other persons in the immediate area shall be wearing safety shoes and a hard hat.

The person in-charge shall give all instructions during the lift. The other 2 technicians shall be positioned as follows (1 on the ground operating the crane and one on the MuID platform for fine positioning of the collar and attachment of the fastening hardware.

1. Contact C-A vacuum group and request that the vacuum isolation valves immediately north and south of the PHENIX IR be closed. Verify that these valves are closed before proceeding.
2. Clear the lift area of all personnel and equipment not involved in the installation operation.
3. Position the IR crane with the hook directly over the central boss (center of gravity) of first (east) collar half and lower the hook to about 3 feet above the collar.
4. Attach swivel eyes to the 3 tapped support holes as shown in figure 4. Make sure the outboard tapped holes used are the set that will be facing up when the collar half is in its installed position (Note: there are 2 sets of tapped outboard holes on both collar halves so that the halves are identical and either half could be used as either the east or west half.)
5. Attach the chainfall to the central cg boss swivel eye using an M 5/8 shackle. Attach the other end of the chainfall to the tufflex polyester 3 foot sling which is in turn attached to the crane hook.
6. Attach the 10 ft liftall slings to each of the other 2 outboard swivel eyes using M 5/8 shackles. Attach the other end of each of these slings to the crane hook using a 10 ton D-ring.

7. Remove all slack on the chainfall until it there is some tension in the chain.
8. Begin raising the hook vertically until the collar half is about 2 feet above its rest position on the floor grating.
9. Manually rotate the collar slowly in a horizontal plane so that the flange side of the collar is facing north.
10. Using the chainfall extend the chain so that the collar rotates vertically until the outboard lifting holes face vertically upward.
11. Position the collar north-south so that it is within a few inches of the southernmost clear vertical east-west plane in the lift area. (i.e. as far as practical from the MMS during the lift)
12. Using the east-west drive for the IR crane slowly move the collar west until the crane is near the beam pipe but no closer than 3 feet from the beam pipe. Make sure that the load is moved slowly enough so it does not sway more than 1 inch when the cranes horizontal motion is stopped or started.
13. **(West collar half only)** Lift the collar using the crane vertically until the bottom of the collar is more than 4 feet above the beam pipe.
14. **(West collar half only)** Move the collar slowly west until it is 3 feet or more past the beam pipe.
15. Raise the collar (for the west collar lower the collar) until the centerline of the collar is in the horizontal plane of the beampipe centerline.
16. With the operator on the MuID platform manually guiding the collar, slowly move the collar closer to the beampipe until it is in its installed east-west position.
17. With the operator on the MuID platform manually guiding the collar, slowly move the collar north making fine adjustments with the east-west and vertical position using the crane guiding the collar to its final position.
18. Install the mounting bolts, alternating between upper lower and middle bolts and using the crane to nudge the collar half as necessary until all bolts are installed. Fully tighten the bolts in the same alternating pattern. Until the collar is fully installed.
19. Lower the crane hook slightly to create slack on the slings an chainfall, carefully observing any movement of the collar to verify that it is fully and securely mounted to the MMS.

20. Lower the crane hook a few more inches to take all load off the slings, detach the slings, swivel eyes, shackles, etc from the collar and raise/move the crane as necessary to avoid contacting the collar and/or beampipe while lowering the lifting hardware to prepare for lifting the next collar by positioning the crane hook directly over the central boss (center of gravity) of the second (west) collar half and lower the hook to about 3 feet above the collar.
21. Repeat steps 4 thru 19 for the west collar.
22. Lower the crane hook a few more inches to take all load off the slings, detach the slings, swivel eyes, shackles, etc from the collar and move the crane as necessary to avoid contacting the collar and/or beampipe while lowering the lifting hardware to for removal and storage until next needed. After all lifting hardware has been removed from the hook, raise the crane hook to inside the crane bridge and move the hook and bridge to their stow position for the duration of the next run.
23. Notify C-A vacuum group that the collar installation is complete and request that the vacuum isolation valves immediately north and south of the PHENIX IR may now be opened and verify that the valves are opened.

Note: Removal of the collar is essentially the same sequence in reverse. The same precautions training and prerequisites apply.

## **6.0 Documentation**

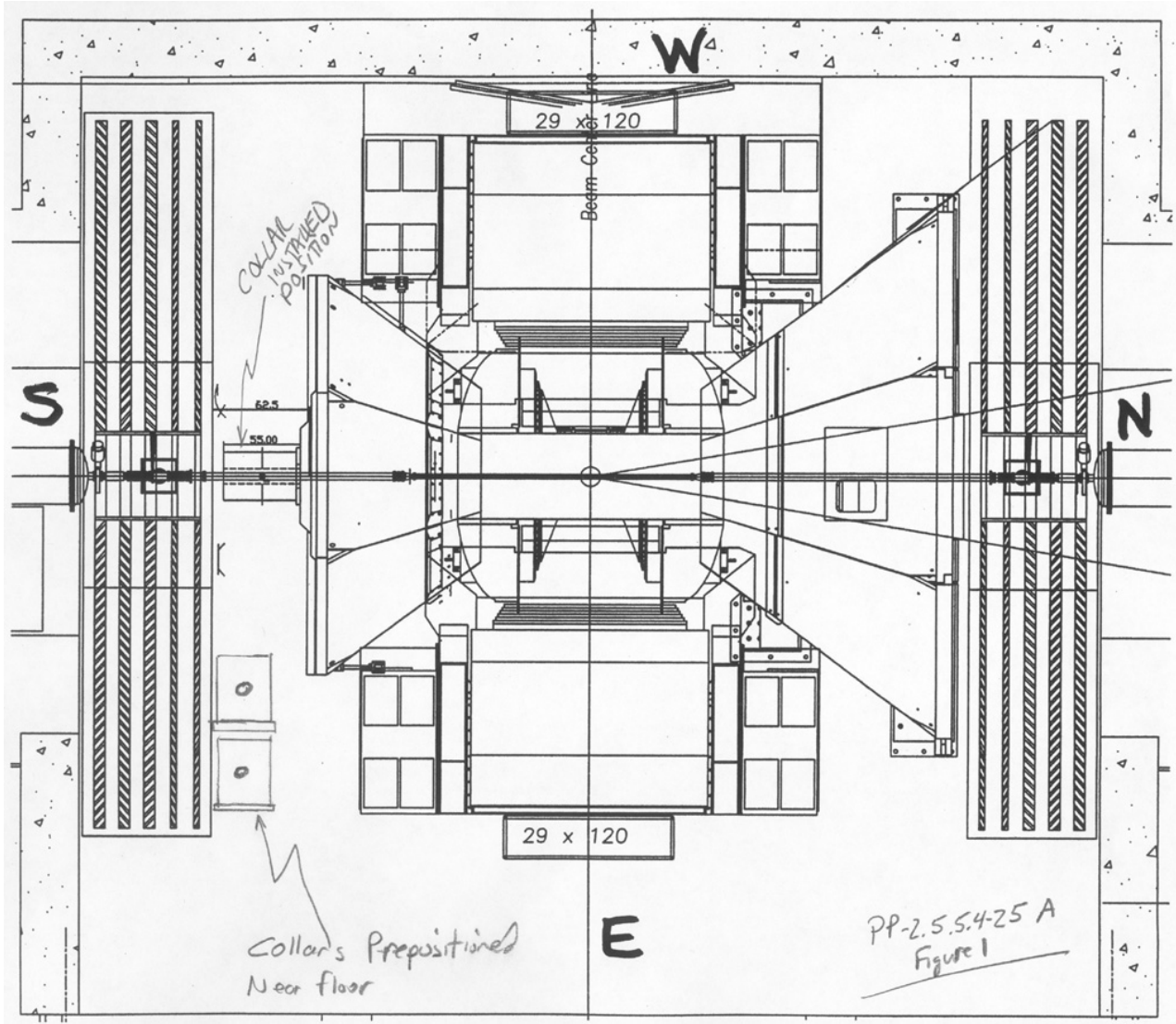
Load and cg calculations for the collar and Critical/Pre-engineered lift evaluation form for the lift described herein, structural design calculations, purchasing documentation and QC documentation for the MuID collar design and fabrication are maintained by the PHENIX configuration control system. These items are available on request.

## **7.0 References**

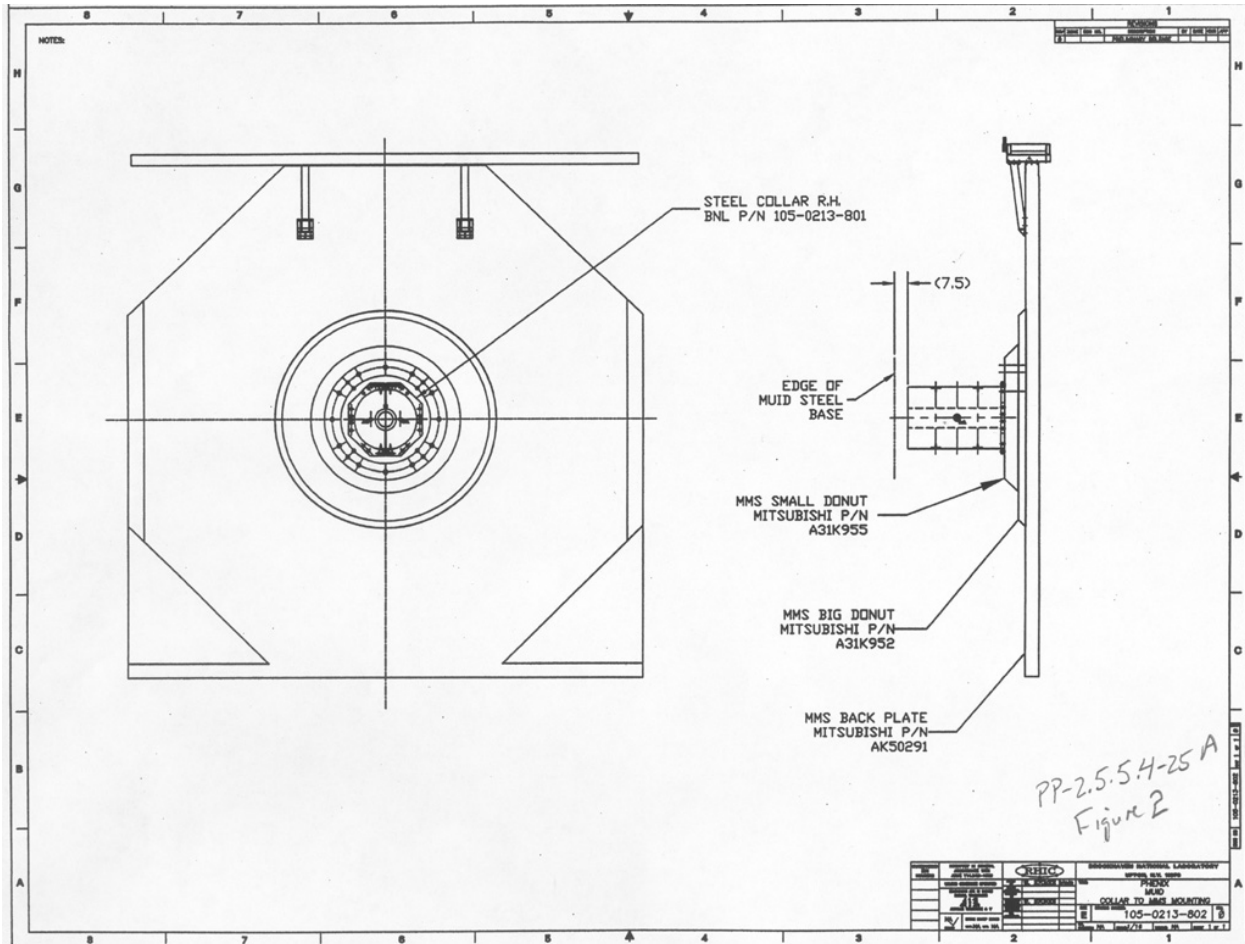
BNL Worker Safety and Health System, Lifting Safety Subject Area, 1. Conducting Critical and Pre-engineered Lifts.

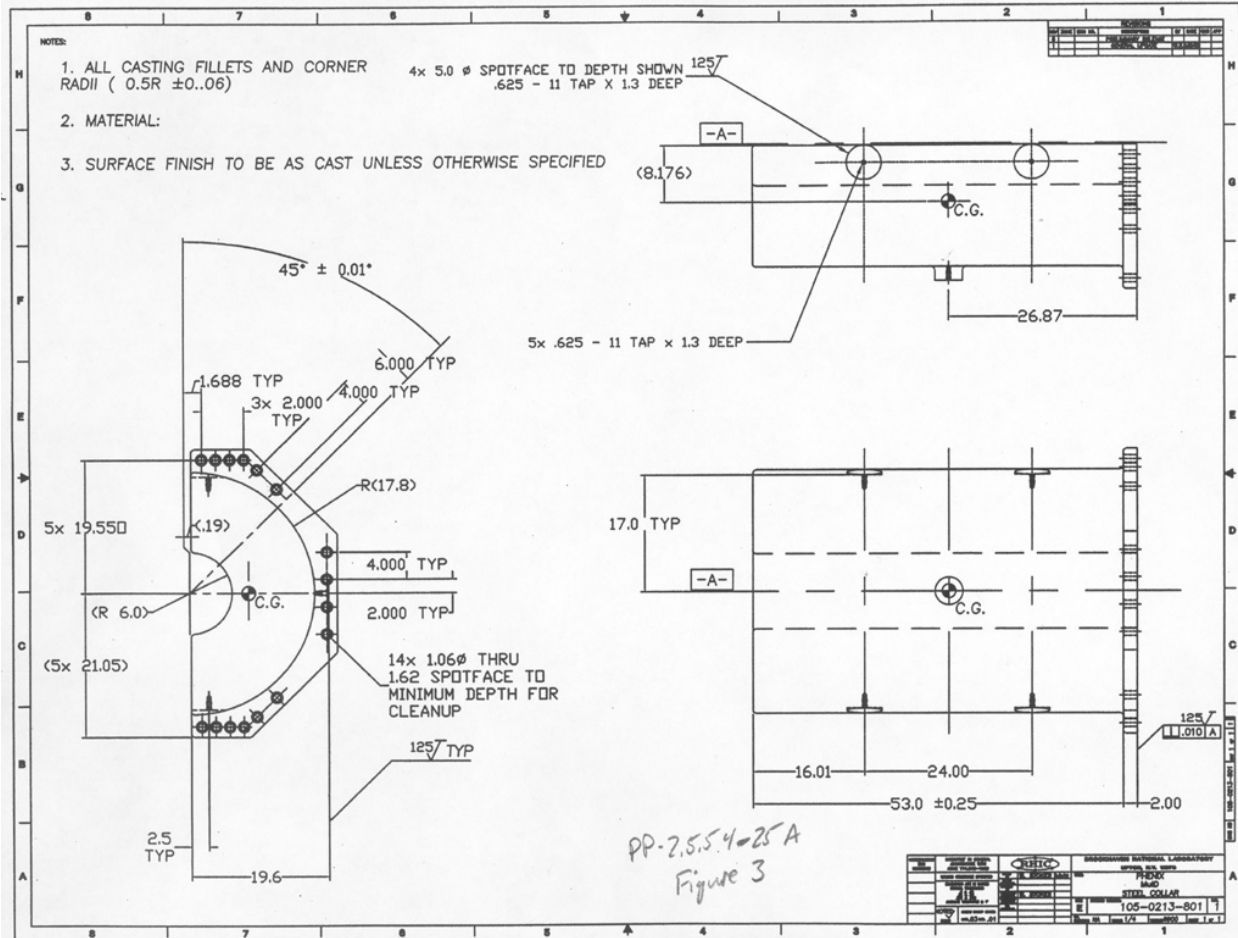
## **8.0 Attachments**

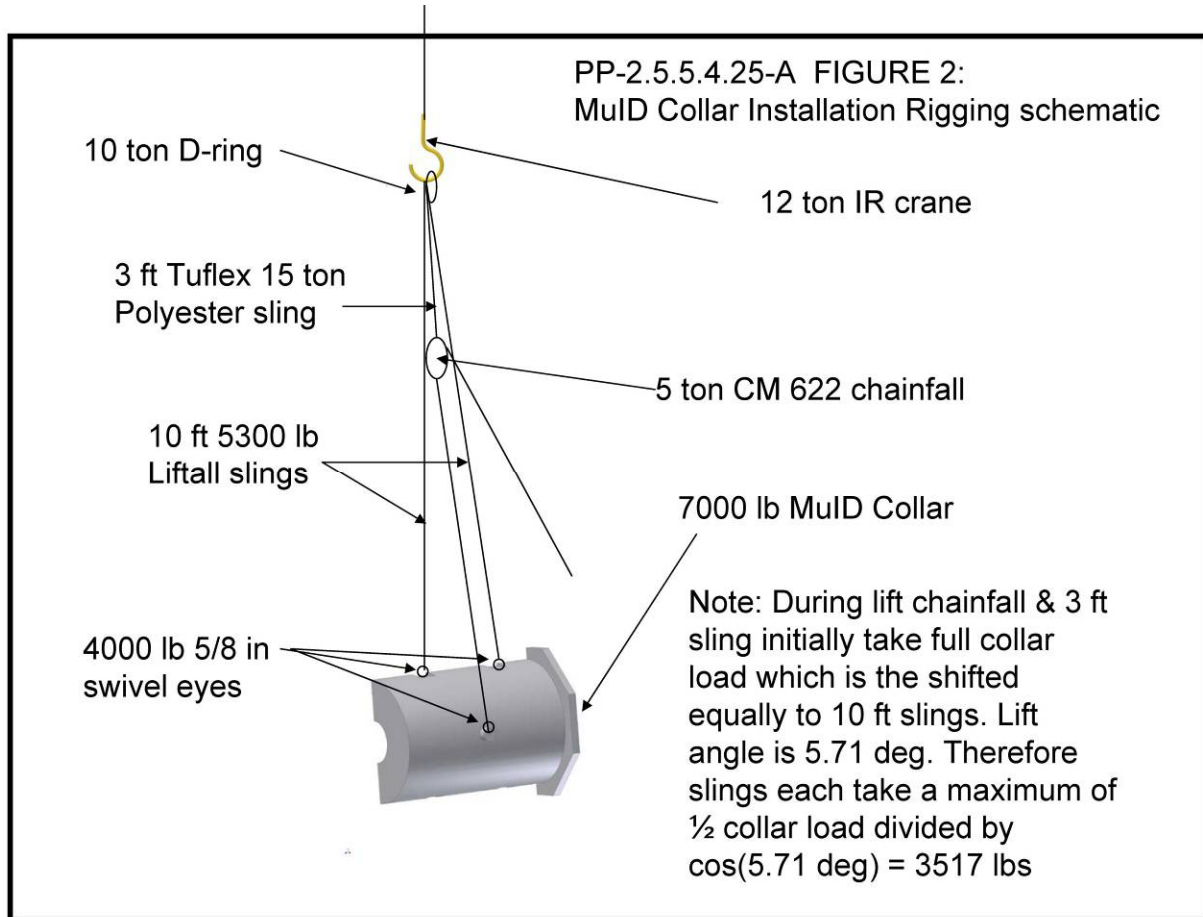
- Figure 1: Lift area plan view
- Figure 2: Lift area elevation view
- Figure 3: MuID collar design and cg
- Figure 4: Lifting apparatus schematic



# PHENIX Procedure # PP-2.5.5.4-25 Rev A







## CRITICAL LIFT EVALUATION FORM (CLEF)

- ☐ Critical Lift
- ☐ Pre-engineered Lift

### PERSON REQUESTING THE LIFT

Print Name Donald Lynch

Dept/Div. PO/PHENIX

Date 1/31/2007

### PERSON IN CHARGE (PIC)

Print Name Sal Marino

PIC must be present during the entire CRITICAL LIFT and be QUALIFIED to resolve any question or problems that might arise during the lifting operation.

### DETERMINING FACTOR FOR CRITICAL LIFT

- NO** Load is greater than 85% of mobile crane rated capacity, or greater than 90% of rated fixed crane capacity, or greater than 50 tons.
- NO** Two or more cranes/booms are required or special hoisting/rigging equipment will be used.
- NO** Potential for release of radioactive/hazardous materials due to collision, or upset of load.
- NO** Damage that would result in more than 3 weeks or 30% delay to schedule, or monetary value damages of \$250,000 or greater.

### ~~OPERATING EQUIPMENT (mobile crane) *Not Applicable*~~

Type of Crane \_\_\_\_\_ Manufacturer \_\_\_\_\_  
Model No. \_\_\_\_\_ Serial No. \_\_\_\_\_  
Manufacturer Restriction for WIND SPEED \_\_\_\_\_ (no lifts at wind speeds of 25 mph or greater)  
Crane Equipped with Anemometer \_\_\_\_\_ (if not, use BNL Weather Station)  
Copies of Latest Annual Inspection \_\_\_\_\_ Latest Calibration Date of Instruments \_\_\_\_\_  
Operator Licensed for Equipment \_\_\_\_\_ Expiration Date \_\_\_\_\_

### OPERATING EQUIPMENT (overhead cranes)

Type of Crane \_\_\_\_\_ Manufacturer \_\_\_\_\_  
Capacity \_\_\_\_\_ Latest Calibration Date of Instruments \_\_\_\_\_  
Date of Latest Annual Inspection \_\_\_\_\_ Operator's SAC Expiration Date \_\_\_\_\_

### DESCRIPTION OF ITEMS TO BE LIFTED

Cast Steel MuID Collar. Collar is split into 2 half cylinders, which are hoisted independently and attached to the south end of the South Muon Magnet in the PHENIX IR. Procedure and supporting documentation are attached. Total gross weight (load + rigging) is less than 7000 lbs (breakdown below) Maximum load elevation is approximately 20 feet (collar cg above raised floor platform).

### HOW WEIGHT OF OBJECT OBTAINED

A. Certified Weight Scale \_\_\_\_\_ Ticket # \_\_\_\_\_

B. Calculated Independently by More than One Source

1. Source Don Lynch, P.E. Weight 6969.2 lbs

2. Source Rich Ruggiero (using Inventor) Weight 6900.7 lbs

C. If lift is an existing item (being removed or demolished), the weight must be recalculated, taking into account all modifications, including internal, as well as an Allowance for Scale, Sediment, Sludge, and Insulation. Calculation Work Sheets SHALL be included in the LIFT PLAN and have a PE stamp or be signed off by a QUALIFIED PERSON. (When weights are calculated, a 10% tolerance margin shall be added. This value may be increased at the discretion of the Lifting Safety Committee).

D. Shipping Manifests Weight \_\_\_\_\_ Manufacturer Data Weight \_\_\_\_\_

**CENTER OF GRAVITY (CG)**

CG will be marked onto load, and a drawing included in procedure showing how it was determined.

**DESCRIPTION & WEIGHT OF ALL RIGGING EQUIPMENT & CRANE ATTACHMENTS**

Type of slings	<u>Liftall 10'</u>	Rated Capacity	<u>5300 lb</u>	Weight	<u>~5 lbs</u>
	<u>Tuflex Polyester</u>		<u>15 ton</u>		<u>~5lbs</u>
Shackles	<u>M 5/8</u>		<u>5 tons</u>		<u>~2 lb</u>
Lifting Rings/	<u>D Ring</u>		<u>10 tons</u>		<u>~ 2 lb</u>
Eyebolts	<u>5/8 swivel</u>		<u>4000 lb</u>		<u>~2 lb</u>
Riggings Hooks					
Load Block/Jib	<u>CM 622 Chain fall</u>		<u>5 tons</u>		<u>~25 lbs</u>

Spreader Bars/Below the Hook Lifting Devices Rated Capacity \_\_\_\_\_ Weight \_\_\_\_\_

**(Must comply with ASME B30.20 Standard for Design, Testing, and Appropriate Markings)**

**200 %**

**PROOF TEST DOCUMENTATION FOR BELOW THE HOOK RIGGING:****WEIGHT OF OBJECT, RIGGING EQUIPMENT, & CRANE ATTACHMENTS**

Source Don Lynch Total Weight <7300 lbs (Includes 10% calculation tolerance)

**EQUIPMENT AND LIFT RELATIONSHIP**

- A. Maximum Operating Radius: Not Applicable
- B. Planned Operating Radius: Not Applicable
- C. Allowable load at maximum lift radius anticipated (from Load Chart): Not Applicable
- D. Ratio of Lift to Allowable Load: Not Applicable
- E. Clearance between Boom & Lift: Not Applicable
- F. Clearance to Surrounding  
Facilities/Utilities: Adequate
- G. Clear Path for Load Movement Adequate

**STABILITY OF GROUND AREA**

- A. Soil Bearing Capacity: Not Applicable Source: Not Applicable
- B. Mats Required: Not Applicable Size & Number: Not Applicable
- C. Underground Utilities Location: Not Applicable
- D. Ratio of Soil Bearing Capacity to Actual: Not Applicable

**LIFTING OPERATION**

A detailed drawing, to scale, MUST be included showing the Set-up Area, Lifting Area, Load Placement Area, and Sling Attachment Points w/sling angle reduction factor. A documented Critical Lift Plan or Pre-engineered Lift Procedure, as applicable, shall be included.

**INSPECTION OF CONTRACTORS EQUIPMENT**

All contractors' Lifting and Rigging Equipment must be inspected before being brought onto the BNL Site by BNL Hoisting & Rigging Inspector: Contact: John Hynan: (631) 344-5456 *All items were inspected 12/06 as Required for annual inspections*

**LIFT APPROVAL SIGNATURES**

Professional Engineer/ Qualified Person: \_\_\_\_\_  
 Person in Charge (PIC) (Critical Lift): \_\_\_\_\_  
 Operator of Equipment (Critical Lift): \_\_\_\_\_  
 Responsible Manager or Designee: \_\_\_\_\_  
 Lifting Safety Committee Recommendation: Approve: \_\_\_\_\_ Disapprove: \_\_\_\_\_  
 LSC Committee Chair: \_\_\_\_\_

**FINAL APPROVAL SIGNATURE:**

Deputy Director for Operations \_\_\_\_\_

**PRE-LIFT MEETING**

Date: \_\_\_\_\_ Time: \_\_\_\_\_ Location: \_\_\_\_\_

## **LIST OF ALL ATTACHMENTS**

PHENIX Procedure PP-2.5.5.4-25 (This includes figures for scale elevation and plan view drawings of the lift site) drawing showing load cg, and Sketch showing rigging setup.

Engineering Calculation of collar weight and cg (by Don Lynch) with computer generated analysis (by Rich Ruggiero) of same as verification.

Also available on request are purchasing QC documentation for collar casting procurement and Structural analyses of installed collar.



**Relativistic Heavy Ion Collider (RHIC): PHENIX Experiment**  
**BROOKHAVEN NATIONAL LABORATORY**  
**ENGINEERING CALCULATION**

**No.**  
**Date:** 2/6/07  
**Rev.:** A  
**PAGE** 1 **of** 3

<b>TITLE</b> MuID Collar weight and center of gravity	<b>PREPARED BY:</b> <u>Don Lynch, P.E.</u>
	<b>CHECKED BY:</b> <u>Rich Ruggiero</u>

**MuID weight and center of gravity (cg) Calculations**

Material = cast steel per ASTM A-27

Density = .281 lb/cu ft

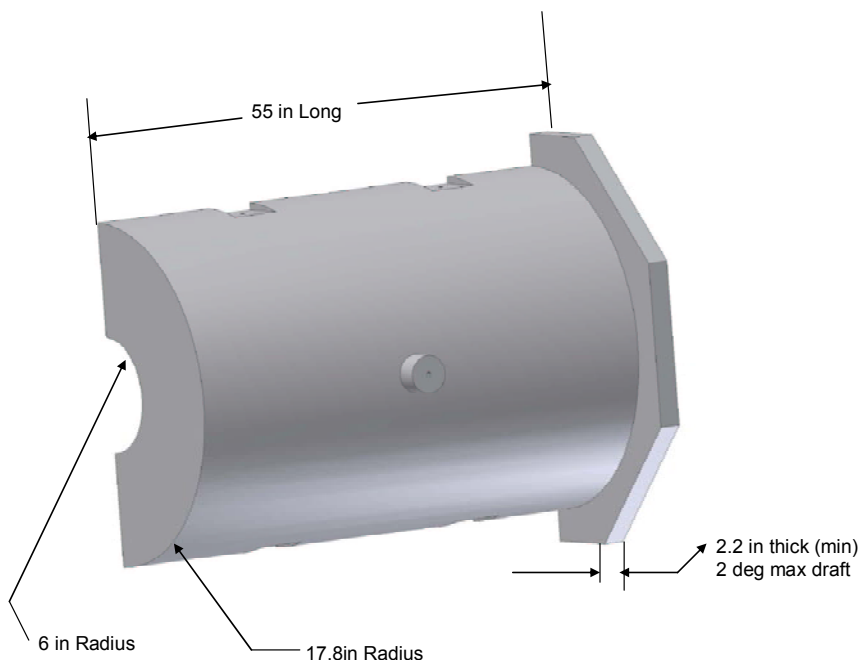
Weight is sum of Cylindrical section + Flange section

$$\text{Cyl. Weight} = \pi \times (17.8^2 - 6^2)/2 \times 55 \times .281 = 6817.9 \text{ lbs}$$

$$\text{Flange weight} = [ (42.1 \times 21.05) - 12.55^2 - (\pi \times (17.8^2)/2 - 16 \times (\pi \times (0.56^2)/2) ] \times 2.6 \times .281 = 157.3 \text{ lbs}$$

(Note use 2.6 in thick flange as average thickness of flange with maximum draft angle.)

$$\text{Total weight} = 6975.2 \text{ lbs}$$





**Relativistic Heavy Ion Collider (RHIC): PHENIX Experiment**  
**BROOKHAVEN NATIONAL LABORATORY**  
**ENGINEERING CALCULATION**

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**TITLE**

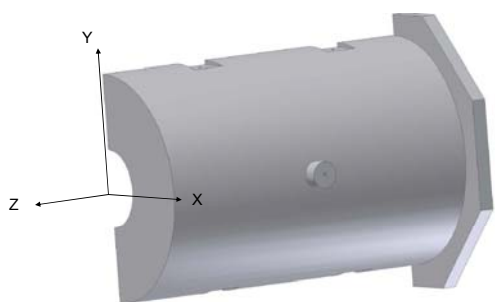
MuID Collar weight and center of gravity

**PREPARED BY:** Don Lynch, P.E.

**CHECKED BY:** Rich Ruggiero

**MuID Collar cg**

Using the coordinate system shown below,



It is obvious by inspection that the collar is symmetric about the **Z**-axis in the YZ-plane. Define the origin for the coordinate system as the intersection of a vertical plane and a horizontal plane intersecting the Z axis (XZ-plane = plane of symmetry) and a the vertical plane through the southern-most surface of the collar.

Use a table to calculate the cg's in the X and Z directions by ignoring minor features (the tapped holes and associated flats and boss and mounting holes) and reducing the structure to a collection of simple structures as follows: + main cylinder, - central cylinder space, + rectangular flange, - main cylinder cutout, - triangular flange corner cutouts.

<b>Item</b>	<b>weight</b>	<b>Xc</b>	<b>Zc</b>	<b>WXc</b>	<b>WZc</b>
Main cyl.	7692	7.55	27.5	58075	211530
Cen cyl space	-874	2.55	27.5	-2229	-24035
Rect flange	636	10.53	53.7	6813	34744
Main cyl cutout	-364	7.55	53.7	-2748	-19547
Tri flange corners	-115	16.87	53.7	-1940	-6175.6

Totals                      6975                      ---                      ---                      57971                      196516

Overall Xc =  $57971/6975 = 8.31$  in    Overall Zc =  $196516/6975 = 28.17$  in



**Relativistic Heavy Ion Collider (RHIC): PHENIX Experiment**  
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TITLE MuID Collar weight and center of gravity

PREPARED BY: Don Lynch, P.E.

CHECKED BY: Rich Ruggiero

mass property results of MuID Collar calculated using Inventor™ software by R. Ruggiero

Volume  $24557 \times 0.281 = 6900.7$  lbs

Physical Properties for 105-0213-801

General Properties:

Material: {Cast Steel}

Density:  $2.8359922\text{E-}001$  lbmass/in<sup>3</sup>

Volume:  $2.456\text{E+}004$  in<sup>3</sup>

Mass:  $6.965\text{E+}003$  lbmass

Area:  $6.9\text{E+}003$  in<sup>2</sup>

Center of Gravity:

X:  $8.300\text{E+}000$  in

Y:  $2.105\text{E+}001$  in

Z:  $2.688\text{E+}001$  in

Mass Moments of Inertia with respect to Center of Gravity(Calculated using negative integral)

Ixx  $2.417\text{E+}006$  lbmass in<sup>2</sup>

Iyx Iyy  $-2.931\text{E+}000$  lbmass in<sup>2</sup>  $1.940\text{E+}006$  lbmass in<sup>2</sup>

Izx Izy Izz  $1.901\text{E+}004$  lbmass in<sup>2</sup>  $1.164\text{E+}001$  lbmass in<sup>2</sup>  $7.803\text{E+}005$  lbmass in<sup>2</sup>

Mass Moments of Inertia with respect to Global(Calculated using negative integral)

Ixx  $1.054\text{E+}007$  lbmass in<sup>2</sup>

Iyx Iyy  $-1.217\text{E+}006$  lbmass in<sup>2</sup>  $7.453\text{E+}006$  lbmass in<sup>2</sup>

Izx Izy Izz  $-1.535\text{E+}006$  lbmass in<sup>2</sup>  $-3.941\text{E+}006$  lbmass in<sup>2</sup>  $4.346\text{E+}006$  lbmass in<sup>2</sup>

Principal Moments of Inertia with respect to Center of Gravity

I1:  $2.417\text{E+}006$  lbmass in<sup>2</sup>

I2:  $1.940\text{E+}006$  lbmass in<sup>2</sup>

I3:  $7.801\text{E+}005$  lbmass in<sup>2</sup>

Rotation from Global to Principal

Rx:  $-5.767\text{E-}004$  deg

Ry:  $6.656\text{E-}001$  deg

Rz:  $3.292\text{E-}004$  deg

